catagory 'A', AK

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UK CL (Edition J) H4T TDAA
INT CL[4] G06F, G09G, H04N

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(54) **Teletext decoder with reduced page-access time**

(57) The decoder includes a video input processor VIP 10 that derives teletext data from the vertical blanking intervals (VBIs) of a video input signal. A computer controlled teletext circuit CCT 12 responds to a select page command from microcomputer 16 to acquire data corresponding to a selected page, and to decode the acquired data. The CCT 12 can adopt either a VBI mode, looking for teletext data only in VBIs of a video signal, or a full-field mode. A memory controller 42 receives data from the VIP 10 and continuously extracts teletext data therefrom and stores the extracted data on a FIFO basis in memory 40. The memory controller 42 inhibits the storage of at least one predetermined teletext extension packet, e.g. packet 31 and/or 30.

Upon a page request, the microcomputer 16 puts the CCT 12 into the full-field mode and supplies the memory controller 42 a scan request SR that causes it to supply the CCT 12 with the data stored in memory 40 in place of the data from VIP 10.

Operating in full-field mode reduces page-access time.

Memory 40 may contain one or more teletext magazines.

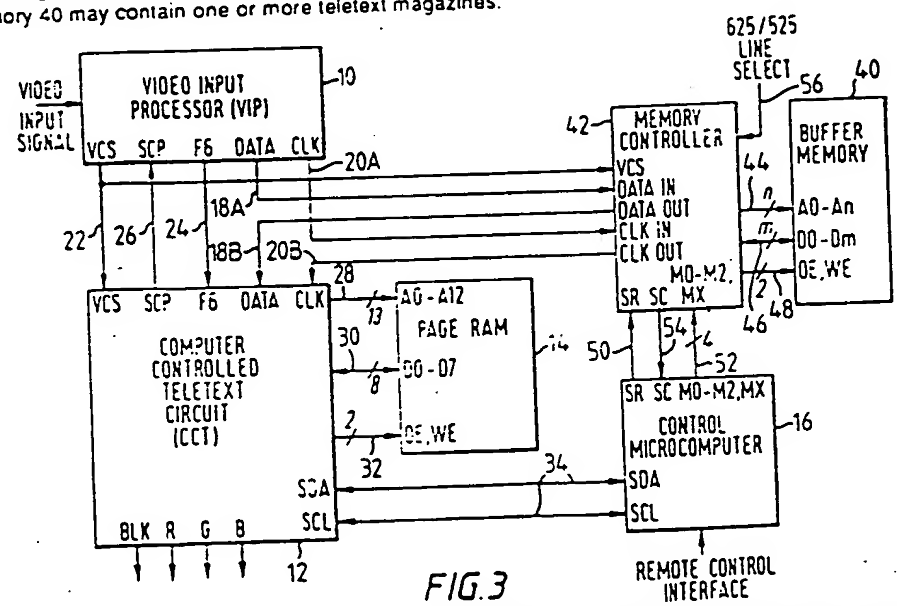

FIG.3

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy

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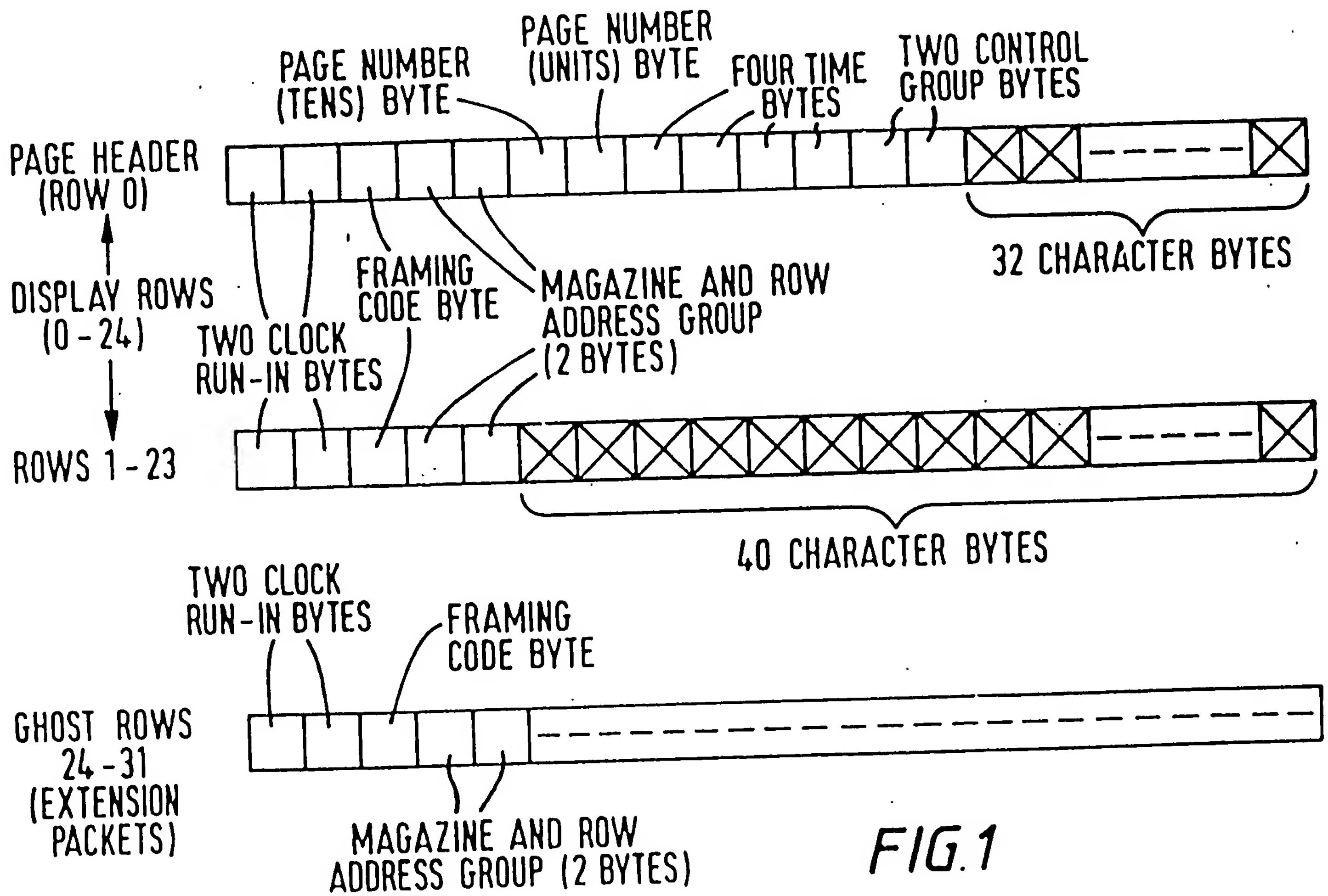


PAGE NUMBER
(TENS) BYTE
PAGE NUMBER
(UNITS) BYTE
FOUR TIME
BYTES
TWO CONTROL
GROUP BYTES
PAGE HEADER
(ROW 0)
32 CHARACTER BYTES
DISPLAY ROWS
(0 - 24)
TWO CLOCK
RUN-IN BYTES
FRAMING
CODE BYTE
MAGAZINE AND ROW
ADDRESS GROUP
(2 BYTES)
ROWS 1 - 23
40 CHARACTER BYTES
TWO CLOCK
RUN-IN BYTES
FRAMING
CODE BYTE
GHOST ROWS
24 - 31
(EXTENSION
PACKETS)
MAGAZINE AND ROW
ADDRESS GROUP (2 BYTES)

FIG.1

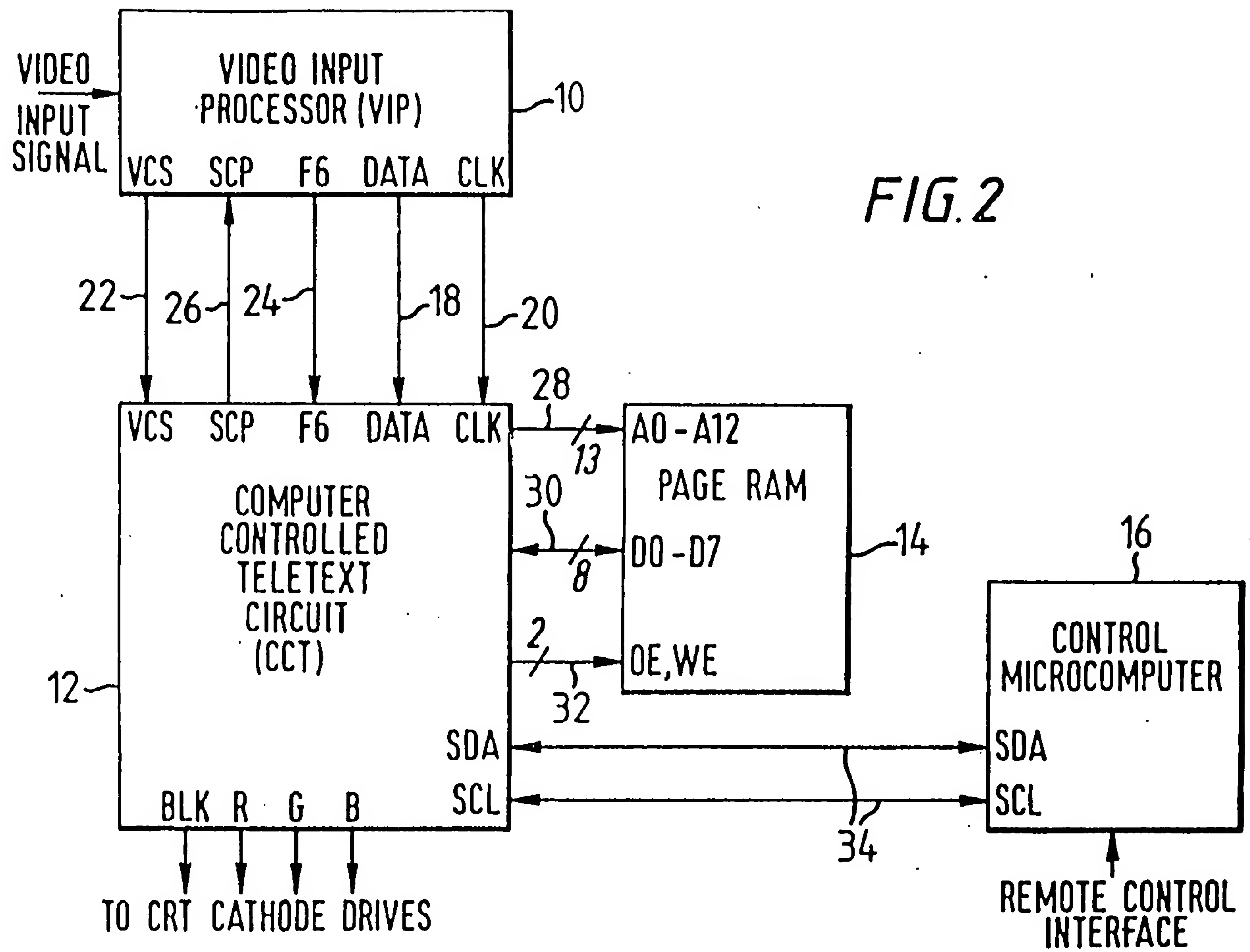

VIDEO INPUT SIGNAL
VIDEO INPUT PROCESSOR (VIP)
VCS SCP F6 DATA CLK
10
22
26
24
18
20
28
13
30
8
2
32
COMPUTER CONTROLLED TELETEXT CIRCUIT (CCT)
VCS SCP F6 DATA CLK
SDA
SCL
BLK R G B
12
TO CRT CATHODE DRIVES
A0 - A12
PAGE RAM
D0 - D7
OE,WE
14
16
CONTROL MICROCOMPUTER
SDA
SCL
34
REMOTE CONTROL INTERFACE

FIG. 2

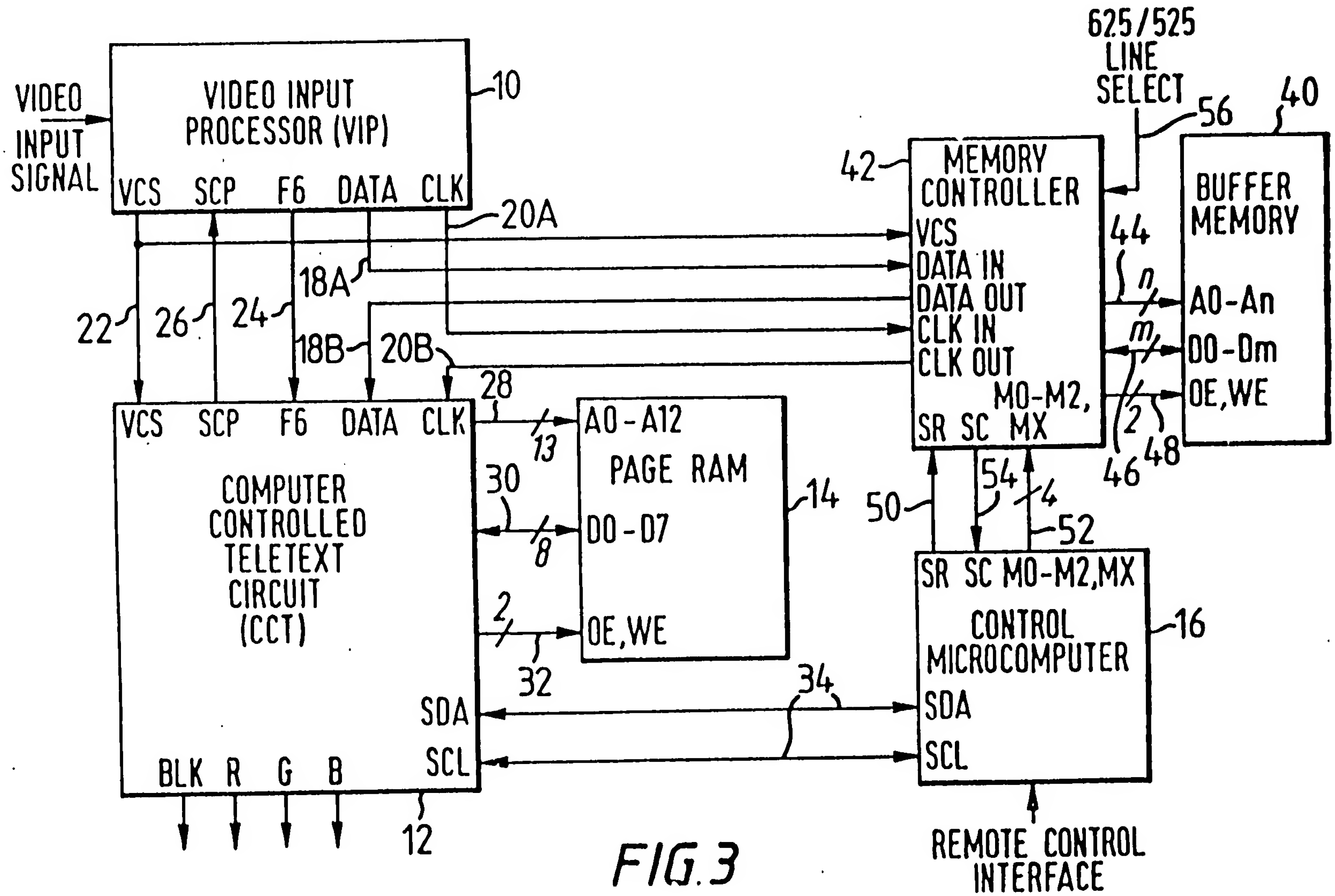
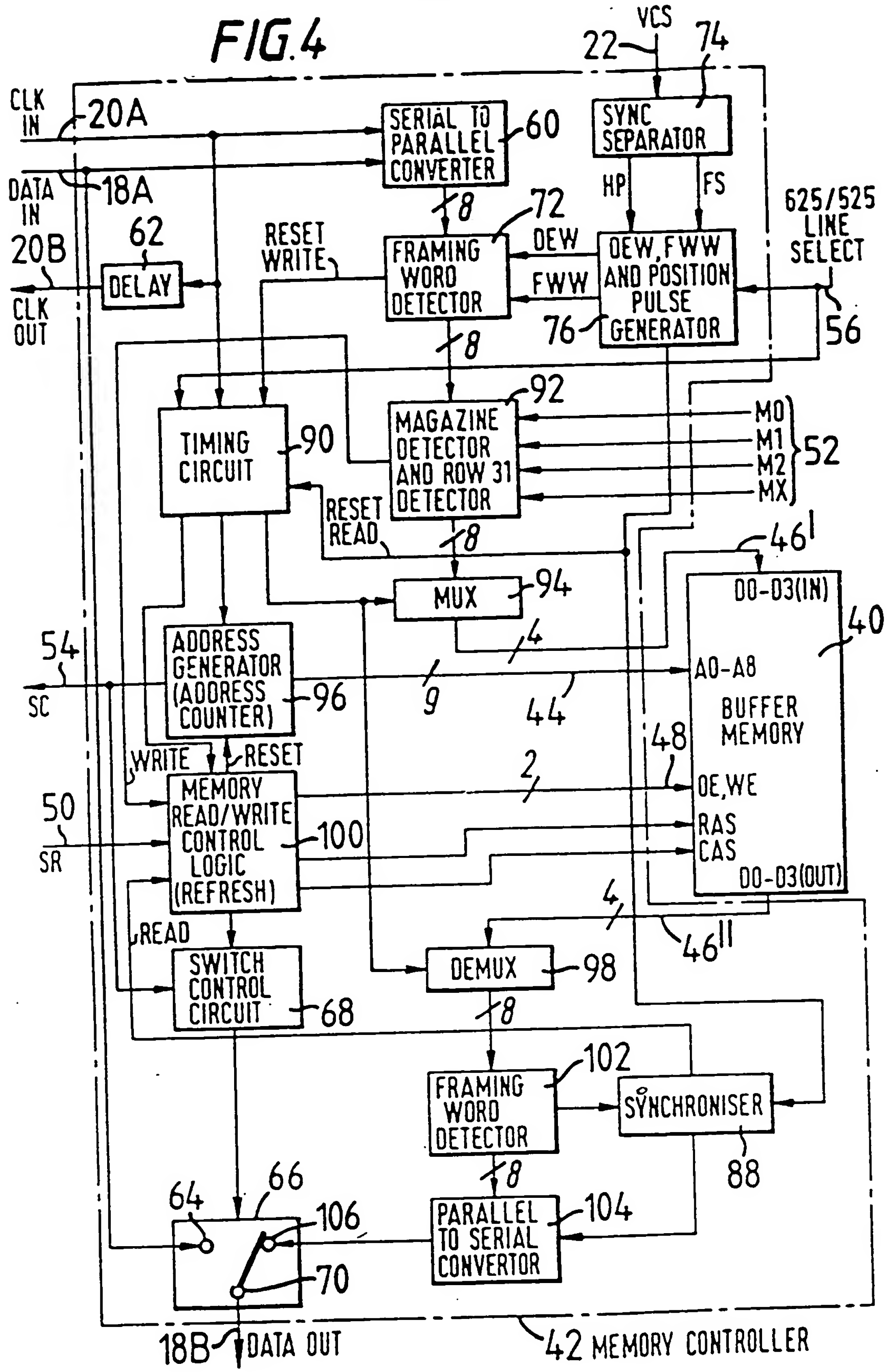

VIDEO INPUT SIGNAL
VIDEO INPUT PROCESSOR (VIP)
VCS
SCP
F6
DATA
CLK
10
20A
22
26
24
18A
18B
20B
28
COMPUTER CONTROLLED TELETEXT CIRCUIT (CCT)
VCS
SCP
F6
DATA
CLK
SDA
SCL
BLK
R
G
B
12
A0 - A12
PAGE RAM
D0 - D7
OE,WE
13
8
2
30
32
14
34
625/525 LINE SELECT
56
MEMORY CONTROLLER
VCS
DATA IN
DATA OUT
CLK IN
CLK OUT
M0-M2, MX
SR SC
42
44
n
m
2
46
48
BUFFER MEMORY
A0-An
D0-Dm
OE,WE
40
50
54
4
52
SR SC M0-M2,MX
CONTROL MICROCOMPUTER
SDA
SCL
16
REMOTE CONTROL INTERFACE

FIG.3

FIG.4



VCS
22
74
CLK IN
20A
SERIAL TO PARALLEL CONVERTER
60
SYNC SEPARATOR
DATA IN
18A
HP
FS
72
62
RESET WRITE
FRAMING WORD DETECTOR
DEW
DEW, FWW AND POSITION PULSE GENERATOR
625/525 LINE SELECT
20B
DELAY
FWW
CLK OUT
76
56
8
92
TIMING CIRCUIT
90
MAGAZINE DETECTOR AND ROW 31 DETECTOR
M0
M1
M2
MX
52
RESET READ
46I
MUX
94
D0-D3(IN)
40
4
54
ADDRESS GENERATOR (ADDRESS COUNTER)
96
A0-A8
SC
9
44
BUFFER MEMORY
48
WRITE
RESET
2
MEMORY READ/WRITE CONTROL LOGIC (REFRESH)
OE,WE
50
RAS
SR
100
CAS
D0-D3(OUT)
READ
46II
SWITCH CONTROL CIRCUIT
DEMUX
98
68
102
FRAMING WORD DETECTOR
SYNCHRONISER
88
66
64
106
PARALLEL TO SERIAL CONVERTOR
104
70
18B
DATA OUT
42 MEMORY CONTROLLER

TELETEXT DECODING APPARATUS

This invention relates to teletext decoding apparatus.

As is well known, the broadcasting of teletext data in most countries conforms to internationally accepted standards. These standards are set forth in a technical specification entitled "World System Teletext and Data Broadcasting System" and published in August 1987 by the Department of Trade and Industry, Kingsgate House, 66-72 Victoria Street, London SW1E 6SW, England (hereinafter referred to as "the World Teletext Standard"), which is based upon "Specification of Standards for Broadcast Teletext Signals" published jointly by the British Broadcasting Corporation (BBC), the Independent Broadcasting Authority (IBA) and the British Radio Equipment Manufacturers Association (BREMA) in September 1976 (hereinafter referred to as "the BBC/IBA/BREMA specification"). Reference should be made to the above-cited documents for full details of accepted teletext standards. A brief description of those aspects of the standards relevant to the present invention is given below.

According to the standards, teletext data is transmitted during lines of the vertical blanking interval (VBI) of a television signal. Transmission of teletext data is permitted only in certain of these lines, not all of which need be used. In the 625 line television system used, for example, in Europe, teletext data may be transmitted in lines 6 to 22 (field 0) and lines 318 to 335 (field 1). The World Teletext Standard also specifies the lines that may be employed in the 525 line television system as used in, for example, Japan and the USA.

Each line of the VBI of a TV field used to carry teletext data is referred to as a "data-line" and, in the 625 line system, each data-line carries all the information needed for one teletext row. At present, 24 such rows (hereinafter referred to as "the display rows") are used to display a page of teletext data. Each row (which may occupy about 20 television display lines) is generated from the information in one data-line. Each row (with the exception of row 0, also known as the page header) carries information for the display of up to 40 characters.

The format of the display rows, namely the rows used to display a page of teletext data, is shown in Figure 1 of the accompanying

drawings. The rows are numbered rows 0 to 23. Each of the rows comprises 45 8-bit bytes or words. The first two bytes are clock run-in bytes providing a clock run-in sequence. They indicate the presence of a data-line and enable bit timing to be established. The third byte is a framing code byte which is a fixed code (11100100) that enables byte synchronisation to be achieved. The fourth and fifth bytes make up a magazine and row address group coded to represent both the "magazine" (which term is explained below) to which the row belongs and the row address (0 to 23).

Each teletext page is represented by a three digit number which is keyed by a user to select that page for display. The first digit represents the magazine (group of 100 pages) and the next two digits represent the number of the page within the magazine. Thus, for example, "345" represents page 45 in magazine 3. The technique for transmission of a selected page is as follows. The transmission begins with the page header (row 0) and ends with (and excludes) the next page header of the selected magazine number. All intermediate data-lines carrying the selected magazine number relate to the selected page, but rows from pages of different magazines may be interleaved in time. Thus, for a particular page, it is not necessary for the page number to be identified in the rows following the page header (row 0). Accordingly, for a particular page, the page number is represented only by the sixth and seventh bytes of the page header (row 0), which identify the tens and units, respectively, of the two-digit page number. As shown in Figure 1, the page number bytes (sixth and seventh bytes) of row 0 are followed by four time bytes and two control group bytes. These in turn are followed by 32 character bytes. In rows 1 to 23, the page number, time and control group bytes are not needed, whereby the fifth byte (the second of the two bytes of the magazine and row address group) is followed by 40 character bytes.

A television receiver having a teletext facility is provided with a teletext decoder for decoding and causing the display of a selected teletext page.

The standard set forth in the BBC/IBA/BREMA specification is known as Level 1 teletext and is the first of a number of downwardly compatible teletext levels known as Levels 1 to 5. To provide for downward compatibility, the World Teletext Standard permits the

transmission of eight further rows (known as "ghost rows" or "extension packets") following the display rows 0 to 24, namely rows 24 to 31. The extension packets or ghost rows are not normally displayed. As is shown in Figure 1, the first five bytes of the extension packets or ghost rows (rows 24 to 31) are the same as those of the display rows (rows 0 to 24). The content of the remaining bytes of the extension packets is determined by the function each extension packet is to perform. At present, teletext transmissions are generally of Level 1. The extension packets or ghost rows enable transmission of further data that will be needed for the higher levels. For more detail, refer to "Characteristics of Teletext Systems", CCIR XV Plenary Session, Geneva, Vol. 11, Report 957, 1982.

Of rows 24 to 31, rows 30 and 31 are of particular relevance to the present invention and will therefore be briefly described.

Row 30 is known as the "data service packet". It constitutes a line or row of information added by the broadcaster to tell the teletext decoder in the television receiver the text, the Julian time and other information selected by the broadcaster, for example that a particular television programme will start at a specified time. Row 30 generally is transmitted at least every second and is updated every five seconds. It can be selectively displayed by the user, for example by his pressing a teletext "time" or "status" button provided on a remote control commander. Row 30 is completely page independent, that is to say it is not (like the display rows) necessarily associated with a particular page whereby it can be accessed merely by causing the decoder (when a user command for row 30 is issued) to look for any received row that has the appropriate magazine number and the appropriate row address (row 30).

Row 31 is known as the data broadcast or datacast row. This row also is completely page independent. Of the lines in the television VBI interval available for sending teletext data, the broadcaster might allocate (say) two or three to contain row 31 information. This information is coded so that it cannot be accessed by ordinary teletext decoders. Authorised users are provided with special datacast decoders that can decode and display the row 31 information. As an example of the usage of row 31 information, the head office of a supermarket chain might rent a data-line for at least part of the day to transmit coded

produce price information to its various branches, which will be equipped with receiving equipment including appropriate special datacast decoders.

The provision of teletext decoders in television receivers is now very well established and has been so for many years. Accordingly, entire decoders, or special chip (integrated circuit) sets which can be assembled to make decoders, are supplied by specialist integrated circuit manufacturers to television manufacturers for incorporation in the television receivers that they make. Such decoders/chip sets have gone through several generations of development. The current generation, now widely used by many manufacturers, is known as Computer Controlled Teletext (CCT). Figure 2 of the accompanying drawings shows a known type of CCT teletext decoder now installed in television sets by various manufacturers. The decoder comprises four standard integrated circuits connected together as shown, namely a video input processor (VIP) 10, a computer controlled teletext circuit (CCT) 12, a page (display) random access memory (page RAM) 14, and a control microcomputer 16. The construction and operation of the decoder of Figure 2 is well known to those skilled in the art and is, for example, described in detail in Mullard (Philips Components) Technical Publication M83-0197. The construction and operation of the decoder of Figure 2 will therefore be described only briefly.

The VIP 10 receives an analogue video input signal from a television receiver in which it is fitted. That signal contains, in the appropriate lines of the VBI interval, an "analogue" version of the transmitted teletext data. The VIP 10 slices the video to regenerate serial data (DATA) and clock (CLK) signals which it outputs on lines 18 and 20, respectively. Also, the VIP 10 generates a video composite synchronisation (VCS) signal which it outputs on a line 22. Further, the VIP 10 generates a 6 MHz clock signal (F6), needed for operation of the CCT 12, which it outputs on a line 24. The signals DATA, CLK, VCS and F6 on the lines 18, 20, 22 and 24, respectively, are passed to respective associated inputs of the CCT 12. The CCT 12 develops a so-called "sandcastle pulse" (SCP) needed for operation of the VIP 10 and supplies it thereto via a line 26. The SCP signal is used to synchronise the generation of the F6 signal to the VCS signal.

The CCT 12 is connected to the page RAM 14 by a 13-bit address bus 28, an 8-bit data bus 30 and a 2-bit bus 32 that supplies either an output enable (read enable) signal OE or a write enable signal WE to the page RAM to cause data to be transferred in either direction between the CCT and the page RAM.

The CCT 12 has blanking (BLK), red (R), green (G) and blue (B) outputs connected to cathode drives of the cathode ray tube (CRT) of the associated television receiver.

The control microcomputer 16 is connected to the CCT 12 by a standard I^2C (inter-integrated circuit control) bus 34 comprising data (SDA) and clock (SCL) portions. The control microcomputer 16 also is connected to a remote control interface to receive and decode remote control pulses from an infra-red receiver connected to a remote control commander, which pulses are indicative of a user selected page request. As well as decoding the remote control pulses, the microcomputer 16 controls the operation of the CCT 12.

In a manner well known to those skilled in the art, and described in the Mullard technical publication cited above, the CCT 12 includes a data acquisition circuit, a timing chain, an interface and control circuit for the I^2C bus 34 (SDA/SL), a character generator, and a memory interface for the page RAM 14. In response to a select teletext page command signal issued by the control microcomputer 16 in response to a user page request from the remote control commander, the data acquisition circuit acquires from the serial data supplied from the VIP 10 on the line 18 (which data comprises sliced video and sliced teletext data corresponding to all pages received) the teletext data corresponding to the selected page and stores it in the page RAM 14. When the page has been written into the page RAM 14, it is then read out, via the memory interface, to the character generator, where it is decoded to form characters to be displayed, in a dot matrix form, each at a desired position on the CRT of the associated television receiver. As known to those skilled in the art, some of the character bytes represent actual characters, whereas other character bytes represent colour changes or instructions to flash the following character and so forth. The character generator performs the function of decoding the information in the character bytes to provide the actual display.

The timing of the foregoing operation is controlled by the timing chain in response to the F6 and VCS signals provided by the CCT 12 on the lines 24 and 22, respectively. The timing chain generates the SCP signal and applies it to the VIP 10 via the line 26.

As mentioned above, the various circuits of the decoder shown in Figure 2 may be standard integrated circuits. For example, in a 625 line teletext decoder, the VIP may be a Mullard (Philips Components) Type SAA5230 or SAA5231 integrated circuit and the CCT 12 may be a European CCT (ECCT) such as a Mullard (Philips Components) Type SAA5240 or SAA5243 integrated circuit. (The term "European", in the foregoing context, means simply that the CCT is designed for the 625 line system as used in Europe (and elsewhere), as opposed to the 525 line system. CCT integrated circuits for use with the 525 line system are also available.) The page RAM 14 may be a standard static RAM (SRAM) having an appropriate storage capacity, and the control microcomputer may be any suitable microcomputer, for example a Mullard (Philips Components) MAB8400.

The capacity of the page RAM 14 will be dictated by the number of pages to be stored. In this regard, the standard ECCT has its acquisition and display sides sub-divided into four so-called "chapters" which can capture, store and display four respective pages. This feature may be used, for example, for the so-called "Fastext" system in which, when some page selections are made, the CCT will capture at least one related page associated with the requested page whereby that related page (already held in the page RAM 14) can be displayed simply by pressing a button on the remote control commander, without waiting for the page to be captured.

In the 625 line ("European") teletext system, there is a one to one correspondence between the 40 character bytes in rows 1 to 23 and the characters displayed on the screen. In the 525 line system, only 32 characters bytes can be put in one data-line. Therefore, groups of four of the 8-byte "remainders" are sent together in subsequent lines and reassembled together in the decoder into 40-byte groups in accordance with the value of a tabulation bit transmitted in the magazine and row address group in the 525 line system. This makes the decoder (more specifically the CCT) in a 525 line system somewhat more complex, though a CCT designed to function with the 525 line system

functions in essentially the same way as an ECCT.

In normal teletext broadcasting systems, as mentioned above, teletext data is transmitted only during certain lines of the VBIs of the television signal, that is to say it is transmitted as an adjunct to video information. However, the World Teletext Standard includes provision for a so-called full field or full channel mode of operation of a teletext decoder for use with a system (not presently in general use) in which teletext can be transmitted in all lines of a television signal, for example in the case of cable transmissions. Though this feature is not usually employed in the CCT 12, conventional CCTs are nonetheless provided with this feature. That is to say, by means of a software command transmitted from the control microcomputer 16 via the I^{2}C bus 34, the CCT can be switched between its normal or VBI mode, in which it looks for teletext data only in lines of VBIs of the television signal, and a full field mode in which it looks for teletext data in all lines of the television signal.

A disadvantage of the conventional teletext decoder is the long average page access time. That is to say, on average, it takes a considerable time between requesting a page and the requested page being displayed, the delay being, of course, due to the need to transmit many pages of data via only a few lines per field of the television signal in normal broadcasting systems.

It has previously been proposed to attempt to alleviate the access time problem by storing a large number of teletext pages which can be accessed (substantially instantaneously) as desired. Specifically, according to one proposal, a special form of CCT is used to decode a large number of received pages and those pages are stored in a very large display memory. This proposal is subject to several disadvantages. Firstly, the CCT cannot be a standard CCT. In this regard, a standard CCT is operative to decode only selected pages. In contrast, in the above-described prior proposal, the CCT is relatively much busier (and therefore, most probably, more expensive) since it is continuously decoding received pages.

According to another prior proposal, which it is believed was not marketed, a special non-standard charge coupled device (CCD) storage arrangement was developed for storing non-decoded pages.

According to the present invention there is provided a teletext decoding apparatus comprising:

a video input processor operative to derive data from a video input signal that contains teletext data in vertical blanking intervals thereof;

a control computer;

a display memory;

a computer controlled teletext circuit responsive to a select teletext page command signal issued by the control computer in response to a user page request to acquire, from said data derived by the video input processor, data corresponding to a selected teletext page, to store said acquired data in the display memory, and to decode said acquired teletext data into a format capable of being displayed, the computer controlled teletext circuit being capable of adopting either a vertical blanking interval mode, in which it looks for teletext data only in lines in vertical blanking intervals of a video signal, or a full field mode in which it looks for teletext data in all lines of a video signal;

a buffer memory capable of storing a plurality of pages of teletext data; and

a memory controller connected to receive the data derived by the video input processor and operative continuously to extract teletext data therefrom and store the extracted teletext data in the buffer memory such that the oldest data is overwritten by the newest data whereby the buffer memory contents are continuously updated, the memory controller including means for detecting and inhibiting the storage in the buffer memory of at least one predetermined teletext extension packet;

the control computer being responsive to a user page request to put the computer controlled teletext circuit into the full field mode and to supply to the memory controller a scan request signal that causes it to supply to the computer controlled teletext circuit, in place of the data derived by the video input processor, the teletext data stored in the buffer memory.

A teletext decoding apparatus in accordance with the invention can if desired be implemented with a standard computer controlled teletext circuit (CCT) in that it takes advantage of the full field

mode available in standard CCTs to stream the stored data quickly into the CCT, in place of "off-air" teletext data, when a page request is made. Thus, the invention can be implemented essentially merely by adding the buffer memory and memory controller to proven and generally available circuitry, subject to a minor modification to the control computer to cause it to put the CCT into the full field mode and to supply the scan request signal to the memory controller (as well as to cause the CCT, as before, to look for a selected page) when a user page request is received. The stored data is then supplied to the CCT, which has been put into the full field mode, whereby the CCT can operate just as if the stored data were "off-air" teletext data received in the full field mode. Thus, since the stored data as applied to the CCT has in effect been time base compressed (with respect to the timing of the data as received off-air) in that it appears to the CCT as if it had been received on all lines of the video input signal, the average page access time is reduced by a factor at least approximately equal to the whole number of lines per field divided by the number of such lines actually used for teletext data transmission. The average page access time will thus be reduced to an extent that it is hardly perceptible to the user. Since the data is stored in non-decoded form in the buffer memory, all this can be achieved without modification of the CCT.

As will be appreciated, it is desirable for reasons of economy to limit the necessary capacity of the buffer memory. The provision of means for detecting and inhibiting the storage of at least one predetermined teletext extension packet furthers this aim, in that it saves memory space by inhibiting the storage of data that would not be useful. Also, it further reduces the average page access time since it prevents the presentation to the CCT of data that the CCT would otherwise (inevitably fruitlessly) examine.

The predetermined teletext extension package whose storage is inhibited may be extension packet (row) 31 described above. In this regard, extension packet (row) 31 information is unavailable to the ordinary teletext decoder and therefore represents, to the ordinary user, a total waste of available transmission capacity. Were the buffer memory to store row 31 information in addition to desired teletext data, there would be an equivalent wastage of space within the

buffer memory and an equivalent amount of presentation to the CCT of non-displayable information. At present, at least on some television channels, the proportion of row 31 information to total information is so significant that the saving in memory achieved by inhibiting the storage of row 31 information is very significant. Bearing in mind that, since a broadcaster can make money by renting television lines to transmit row 31 information, there is a commercial pressure on the broadcaster to increase the proportion of row 31 information to information that can be accessed by the user, this feature might become even more advantageous in the future. In this regard, the transmission of row 31 information involves splitting up data into blocks of 40 bytes on individual data-lines and concatenating the information at the other end. Thus, it is possible to send an open-ended packet of row 31 information. In principle, it is possible to send as much row 31 data as is required, provided it is split into 40 byte blocks. This consumes transmission time which would normally carry display rows and there is no technical limit on the proportion of available teletext transmission capacity which could be allocated to the transmission of row 31 information.

Additionally or alternatively, the teletext extension packet whose storage is inhibited may be extension packet (row) 30 discussed above. In this regard, it is considered that storage of extension packet 30 is not necessary because, since it is transmitted every second or so, the decoder can readily capture it off-air with an access time of no more than about one second, which will be acceptable to the user.

Even though the storage in the buffer memory of at least some data that is not desired is inhibited, it may well not be economical for the buffer memory to have a capacity capable of storing all possible teletext information that could be transmitted. Preferably, however, the buffer memory is capable of storing at least the amount of teletext data (less that in the at least one extension packet whose storage is inhibited) that can be contained in one teletext magazine.

The memory controller may include a magazine detector operative to detect whether or not each line of the teletext data it receives is data from at least one predetermined teletext magazine and the memory controller may be operative to store the teletext data only if the data

is from the at least one predetermined magazine. Thus, if the buffer memory is capable of storing at least one magazine but is not capable of storing all magazines, only that one or more magazines may be stored and, if a page is selected from another magazine, the control computer will cause the CCT to operate off-air. Preferably, the at least one predetermined teletext magazine that the magazine detector is operative to detect can be selectively varied. Thus, for example, the user can select a different one or more magazines at different times of day, for example a magazine directed predominantly to news at one time of day and a magazine directed predominantly to sport at another time of day.

The fact that the data is stored in the buffer memory in non-decoded form leads to a further advantage. This is that, as explained below, the memory controller can be so designed that it readily can be switched to operate in accordance with either the 625 line system or the 525 line system whereby memory controllers of the same type can be installed in teletext decoders of receivers of either the 625 line system or the 525 line system.

The invention will now be further described, by way of illustrative and non-limiting example, with reference to the accompanying drawings, in which like references indicate like items throughout, and in which:

Figure 1 is a schematic representation of the transmission format employed in 625 line teletext broadcast transmission systems;

Figure 2 is a block schematic circuit diagram of a conventional teletext decoder;

Figure 3 is a block diagram of a teletext decoder embodying the present invention; and

Figure 4 shows a memory controller and a buffer memory of the teletext decoder of Figure 3 in more detail.

Figure 3 shows a teletext decoder embodying the invention. The decoder of Figure 3 is a modification of that of Figure 2. The VIP 10, CCT 12 and page RAM 14 of the decoder of Figure 3 can be identical to those of Figure 2.

The decoder of Figure 3 additionally comprises a buffer memory 40 and a memory controller 42. The video composite synchronisation (VCS) signal outputted by the VIP 10 on the line 22 is connected to a corresponding input of the memory controller 42. The line carrying the

data from the VIP 10 to the CCT 12 is split into a line 18A carrying data from the VIP 10 to a DATA IN input of the memory controller 42 and a line 18B carrying data from a DATA OUT output of the memory controller 42 to the CCT 12. Similarly, the line carrying the clock signal CLK from the VIP 10 to the CCT 12 is split into a line 20A carrying the CLK signal to a CLK IN input of the memory controller 42 and a line 20B connecting a CLK OUT output of the memory controller 42 to the CCT 12.

The memory controller 42 is connected to the memory 40 by way of a n-bit address bus 44, an m-bit data bus 46 and a 2-bit control bus 48 supplying output enable (OE) and write enable (WE) signals from the memory controller 42 to the memory 40.

The control microcomputer 16 can be of the same construction as in the decoder of Figure 2, except for the following additional features. The control microcomputer 16 generates a scan request signal SR which it supplies to the memory controller 42 via a line 50, and magazine select signals M0, M1, M2 and MX which it supplies to the memory controller 42 via a 4-bit bus 42. Further, the control microcomputer 16 responds, as explained below, to a scan complete signal SC received from the memory controller 42 on a line 54. Also, in addition to (as in the case of Figure 2) responding to a user page request by supplying to the CCT 12 a select teletext page command signal that causes the CCT to look for the selected page, the control computer 16 is responsive to a user page request also to issue a mode command signal to the CCT to put the CCT (which previously was in its VBI mode) into its full field mode. Both such command signals are sent to the CCT 12 via the I^2C bus 34.

The memory controller 42 is provided, on a line 56, with a 625/525 line select signal which enables the memory controller 42 to function in a teletext decoder of either the 625 line or 525 line system.

The operation of the decoder of Figure 3 will now be described in outline with Figure 3 (and thereafter described in more detail with reference to Figure 4).

Under normal operating conditions, that is prior to a user page request being received, the memory controller 42 connects together its DATA IN input to its DATA OUT output, and its CLK IN to its CLK OUT

output, whereby the data is directed from the VIP 10 to the CCT 12 in the same manner as in the decoder of Figure 2. (This is necessary to enable the CCT to operate off-air in the conventional manner described above because features like the teletext "TIME" feature must be implemented.) Additionally, however, the memory controller 42 extracts teletext data from the signal supplied on the line 18A and writes it to the memory 40 on a first-in, first-out basis. That is to say, once the memory 40 is full the memory controller 42 starts to overwrite the oldest data so that the memory 40 is continuously updated with rows of teletext data. As explained above, the memory controller 42 is operative during this information to inhibit the storage in the memory 40 of at least one extension packet, preferably row 31 and/or row 30.

When a user page request is made, the control microcomputer 16 issues the above-mentioned select teletext page command signal and mode command signal to the CCT 12. The former command causes the CCT 12 to look for the selected page, and the latter command switches the CCT, which was previously in the VBI mode, into the full field mode. At the same time, the microcomputer 16 indicates to the memory controller 42 that it should effect a scan of the memory 40, which it does by changing the level of the scan request signal SR on the line 50. The memory controller 42 is responsive thereto to stop writing data into the memory 40 and, instead, to stream the teletext data stored in the memory 40 to the CCT 12 via the line 18B. The memory controller 42 controls the timing of the streaming of data to the CCT 12 such that one row is sent per TV line whereby it appears to the CCT 12 (which has been put into the full field mode) that full field data is arriving off-air. The CCT 12 looks to see whether the requested page is present in the stored data streamed from the memory 40. If it finds the requested page, the CCT 12 decodes and displays the page and sets a flag. The microcomputer 16 monitors this flag via the I^2C bus 34 and is responsive to the flag to terminate the scan request signal SR (that is, to cause the signal on the line 50 to revert to its previous level) and to put the CCT 12 back into its VBI mode.

While the data streaming operation is proceeding, the memory controller 42 is monitoring the status of the scan request signal SR and is counting the number of rows of teletext data streamed from the memory 40. If the entire content of the memory 40 has been cycled

through and the scan request signal SR has not been terminated, this indicates to the memory controller 42 that the CCT 12 has not found the selected page in the data streamed to the CCT from the memory. In response thereto, the memory controller 42 supplies the scan complete signal SC to the control microcomputer 16 via the line 54 and the microcomputer is responsive thereto to transmit an instruction to the CCT 12, via the I^2C bus 34, to put it back to the VBI mode. Accordingly, the CCT 12 then looks for the requested page in the data arriving directly off-air from the VIP 10 via the memory controller 42.

As mentioned above, the capacity of the buffer memory 40 may not be sufficient to store all possible teletext data that can be received in all magazines. By way of example, in the present embodiment, it is assumed that the capacity of the memory 40 is sufficient only to store the amount of teletext data (less that in the at least one extension packet whose storage is inhibited) that can be contained in one teletext magazine. Thus, the decoder of Figure 3 will operate only in the manner set forth above for that one particular magazine. For other magazines, it will operate in the same manner as the conventional decoder of Figure 2. That is, the control microcomputer 16 is programmed to put the CCT 12 into the full field mode, and to cause data to be streamed thereto from the memory 40, only if a page in the particular magazine is selected. Further, the memory controller 42 contains a magazine detector for the particular magazine and will store only teletext rows that are contained in that magazine (and that are not the at least one predetermined extension packet whose storage is to be inhibited). The identity of the particular magazine is stored in the control microcomputer 16 and is transmitted to the memory controller 42 via the line 52. The particular magazine to be stored is preferably selectable by the user, the microcomputer 16 being responsive to a related command from the user to identify the selected magazine via the lines M0, M1 and M2 of the bus 52. (In this regard, three lines are sufficient to identify the magazine, since a 625 line system can have a maximum of eight magazines and a 525 line system can have a maximum of four magazines.) In the event that, in a particular form of implementation of the decoder of Figure 3, the buffer memory is of sufficient capacity to store the contents of all available magazines, the line MX of the bus 52 can be enabled, which causes the

memory controller 42 to ignore the magazine identification of incoming teletext data and to store all rows of data (except for the at least one predetermined extension packet which is not to be stored).

The operation of the memory controller 42 will now be described in more detail with reference to Figure 4, which shows the detailed construction of the memory controller 42 and also shows the buffer memory 40.

In Figure 4, the buffer memory 40 is shown, by way of example, as being a dynamic random access memory (DRAM). This being so, the buffer memory 40 as illustrated in Figure 4 is additionally provided with row address select (RAS) and column address select (CAS) inputs of conventional form. Furthermore, in the particular configuration shown in Figure 4, each 8-bit byte of teletext data is stored in the form of two four-bit "nibbles", whereby the bus 46 is a four-bit bus, or more exactly a four-bit input bus 46' and a four-bit output bus 46''. Obviously, if some different form of memory 40 were employed, some other form of bus implementation would be employed.

As shown in Figure 4, the CLK IN input of the memory controller 42 is connected to one input of a serial to parallel converter 60 and is also connected to the CLK OUT output via an equalising delay 62. The DATA IN input of the memory controller 42 is connected to another input of the serial to parallel converter 60 and is also connected to a fixed contact 64 of a switch 66 whose operation is controlled by a switch control circuit 68. The DATA OUT output of the memory controller 42 is connected to a movable contact 70 of the switch 66. An output of the serial to parallel converter 60 is connected by an eight-bit bus to a framing word detector 72.

The video composite synchronisation signal (VCS) input of the memory controller 42 is connected to a synchronisation separator 74 which extracts therefrom a horizontal pulse (HP) signal and a field (vertical) synchronisation (FS) signal. These are both supplied to a window generator 76 that generates a data entry window (DEW) signal, a framing word window (FWW) signal and a position pulse signal. The DEW and FWW signals are applied to inputs of the framing word detector 72 which generates therefrom a RESET WRITE signal. The position pulse signal is applied to a synchroniser 88 and (as a RESET READ signal) to a timing circuit 90. The timing circuit 90 also receives the RESET

WRITE signal from the framing word detector 72, the CLK signal from the CLK IN input and the 625/525 line select signal. The 625/525 line select signal also is applied to the window generator 76.

An output of the framing word detector 72 is applied to an input of a magazine detector and row 31 detector 92, to which the 4-bit bus 52 from the control microcomputer is connected. Output (8-bit) data from the detector 92 is passed to a multiplexer 94 where it is multiplexed into 4-bit nibbles (as mentioned above) and supplied to the data input bus 46'. Timing of the operation of various components of the memory controller 42 to process bytes of data is controlled by the timing circuit 90 in accordance with the CLK, RESET WRITE and RESET READ signals. Components of the memory controller 42 controlled by the timing circuit 90 include the multiplexer 94, an address generator 96 (which includes an address counter), a demultiplexer 98, and memory read/write control logic (which also includes means for refreshing the DRAM 40) 100. The address generator 96 generates addresses that are applied to the address bus 44 and also generates, as explained below, the scan complete signal SC.

The memory read/write control logic 100 develops the output enable and write enable signals OE and WE applied to the memory 40 via the bus 48, together with the above-mentioned RAS and CAS signals also applied to the memory 40. As well as receiving timing information from the timing circuit 90, the memory read/write control logic 100 receives a WRITE signal from the detector 92, the scan request SR signal from the control microcomputer 16, and a READ signal from the synchroniser 88. Also, the memory read/write control logic 100 develops a RESET signal for the address generator 96.

The demultiplexer 98 receives 4-bit output nibbles from the memory 40 and demultiplexes these into 8-bit bytes which it applies to a framing word detector 102. The framing word detector 102 outputs a control signal to the synchroniser 88 and outputs 8-bit data to a parallel to serial converter 104, which is under the control of the synchroniser 88. The parallel to serial converter 104 outputs serial data to a fixed contact 106 of the switch 66.

The arrangement shown in Figure 4 functions as follows. Under normal operating conditions, that is to say prior to a page request being received, input data is supplied to the serial to parallel

converter 60. Since, under those conditions, the switch 66 is in the opposite condition to that illustrated in Figure 4, the data is also passed to the DATA OUT output and, from there, to the CCT 12. The converter 60 converts the serial input data (which comprises both teletext data and sliced video) into 8-bit parallel form and passes it to the framing word detector 72.

The window generator 76 enables the framing word detector 72 only in lines of the vertical blanking intervals in which a row of teletext data may occur and only at a position in each such line at which the framing code byte or word of the row may occur. More specifically, the DEW signal enables the framing word detector 72 only in a data entry window which corresponds to that period of a VBI after a field (vertical) synchronisation signal FS in which teletext lines may validly occur, and the FWW signal enables the detector 72 only during that period in each valid teletext line (12 to 15 microseconds from the falling edge of the horizontal synchronisation pulse HP) during which the framing code byte or word (the third byte in the format shown in Figure 1) should occur. If the framing word detector 72 detects a framing code byte or word when enabled, that is, if it detects a valid teletext line, it generates the RESET WRITE signal which sets the timing of the timing circuit 90 to control writing of teletext data into the memory 40 in accordance with the CLK signal. To ensure that only valid teletext lines are detected, the memory controller 42 may be provided with means (not shown) for detecting the last nibble (4 bits) of the clock run-in sequence (refer to the foregoing description of Figure 1), which bits have the values 1010; and be operative to generate the RESET WRITE signal only if both the last nibble of the clock run-in sequence and the framing code byte or word are detected.

Also, if the framing word detector 72 detects a framing code byte or word when enabled, the following part of the teletext row is passed to the detector 92. The detector 92 examines the next two bytes (the magazine and row address group). If it detects that the row does not relate to the magazine selected via the bus 52 and/or if it detects that the row address is that of row 31, the detector 92 does not supply a WRITE signal to the memory read/write control logic 100 whereby writing to the memory 40 is not enabled. If, however, on the other hand, the detector 92 detects that the row being examined is of the

selected magazine and is not row 31, the detector 92 supplies the WRITE signal to the memory read/write control logic 100 which then enables writing of the row into the memory 40. More specifically, as mentioned above, successive character bytes of the row are converted by the multiplexer 94 into 4-bit nibbles prior to storage. More precisely, not just the 40 character bytes, but also the framing code byte or word and the magazine and row address group (2 bytes), are nibbled and stored in the memory 40. The timing circuit 90 is so constructed that, after a framing code byte or word has been detected and this has been indicated to the timing circuit 90 by the RESET WRITE signal from the framing word detector 72, 43 bytes (including the framing code byte or word) will be stored for a 625 line system or 35 bytes (including the framing code byte or word) will be stored for a 525 line system. Thus, as explained above, an entire row of teletext data (less the first two (clock run-in) bytes) has been extracted from the input data and stored.

Then, in the same manner as set forth above, the framing word detector 72 looks for another framing code byte or word and, if the row containing that framing code byte or word relates to the selected magazine and is not row 31, that row also is stored. This process continues indefinitely. Each time, the address generator 96 will, of course, cause each successive stored row to be stored in a respective different memory position. Also, each time, the address counter in the address generator 96 is incremented. When, as determined by the address counter, the memory 40 is full, the address generator starts to overwrite the oldest stored data. That is to say, teletext data as extracted from the incoming data by the framing word detector 72, and as thereafter monitored for magazine and row identity by the detector 92, is continuously updated in that it is stored in the memory 40 on a first-in, first-out basis.

The way in which the memory controller 42 as illustrated in Figure 4 reads data from the memory 40 and sends it to the CCT 12 will now be described. If the control microcomputer 16 receives a user page request that relates to the magazine whose identity currently is supplied to the detector 92 via the bus 52, it generates the scan request signal SR which is applied to the memory read/write control logic 100. In response thereto, the logic 100 disables writing to the

memory and enables reading from the memory, and it causes the switch control circuit 68 to change over the switch 66 to the condition illustrated in Figure 4. Further, the logic 100 resets the address counter by applying the RESET signal to the address generator 96, so that scanning of the contents of the memory 40 starts with the lowest memory address. The stored data is then read out from the memory as 4-bit nibbles and 8-bit bytes are reconstructed by the demultiplexer 98. The framing word detector 102 looks for a framing code byte or word in the data outputted by the demultiplexer 98. The synchroniser 88 is responsive to the detection of a framing code byte or word by the detector 102 and to a position pulse from the window generator 76 to synchronise the timing of the output data with that of the video input signal. More specifically, the position pulse is so temporally related to the horizontal synchronisation pulse HP as to provide that the framing code byte or word as emerging from the memory controller 42 is positioned correctly, that is to say positioned where it would have occurred if the output teletext row had been received off-air. On receipt of a position pulse, the synchroniser 88 supplies the READ signal to the memory read/write control logic 100 so that reading of the following row takes place at the correct synchronised timing, more specifically so that the framing code byte or word is synchronised to the video composite signal VCS so that the framing word is correctly positioned for the CCT 12. The timing circuit 90 is so constituted that, in response to the position signal as applied thereto as the RESET READ signal, 43 bytes (including the current framing code byte or word) will be read out for a 625 line system or 35 bytes (including the current framing code byte or word) will be read out for a 525 line system.

Reading is then continued, for subsequent stored rows, as described above. As mentioned above in the description of Figure 3, the reading operation is terminated if the memory controller 42 is notified, by termination of the scan request signal SR, that the CCT 12 has found the selected page in the stored data streamed from the buffer memory 40. In response thereto, the memory read/write control logic 100 causes the memory controller 42 to stop reading data and to revert to writing data, and causes the switch control circuit 68 to put the switch back into the opposite condition to that shown in Figure 4.

While the above-described reading operation is taking place, the address counter in the address generator 96 is counting the number of outputted stored rows. If that number reaches the capacity of the memory 40 and the scan request signal SR has not been terminated, then (as described above with reference to Figure 3) the address generator 96 generates the scan complete signal SC, which causes the control microcomputer 16 to put the CCT 12 back into the VBI mode and to look for the selected page off-air. Further, when the scan complete signal SC is generated, the memory controller 42 reverts to writing to the memory 40 the data arriving off-air.

An advantage of the memory controller 42 not storing decoded teletext data, but, rather, storing the data in non-decoded or "raw" form, is that it is readily adaptable to function in a 625 line system or a 525 line system. In this regard, as mentioned above, the 625/525 line select input modifies the operation of the timing circuit 90 so that writing (and reading) is effected for respective different numbers of bytes in the case of the two types of system. This is the only operation necessary to take into account the rather different formats of teletext in the two systems. It is not of importance to the memory controller 42 that the 40 character bytes of rows 1 to 23 are each in respective data-lines in the 625 line system but are split between different data-lines in the 525 line systems. Provided it stores the data correctly, the type of system does not matter since it is the task of the decoder in the CCT 12 to perform the decoding. It is only necessary to switch the timing circuit 90 to control the writing (and reading) of respective different numbers of bytes in the respective different systems.

Additionally, however, the timing of the data entry window DEW, framing word window FWW and the position pulse are different between the two systems. The generator 76 is configurable by the 625/525 line select signal to select the appropriate timing in accordance with the system that is employed.

An advantage of the above-described memory controller 42 is that the updating of the buffer memory 40 performed by the memory controller is substantially independent of the size (that is, the storage capacity) of the memory. That is, the memory controller 42 will operate with memories of different sizes, subject only to the count of

the address counter (in the address generator 96) being changed to conform with the memory size. In a preferred arrangement, therefore, the memory controller 42 is so designed that the count of the address counter can be changed between at least two different values whereby, to simplify manufacture and/or to allow the decoder to be upgraded as regards buffer memory size, the same memory controller will function with buffer memories of two or more different sizes. For example, the count of the address counter may be variable by changing a wire link.

The detector 92 of Figure 4 can be so modified as to detect (and inhibit the storage of) any other extension packet (row) than row 31. For example, the detector 92 can be modified to detect (and inhibit the storage of) row 30 or both rows 30 and 31.

CLAIMS

1. A teletext decoding apparatus comprising:

a video input processor operative to derive data from a video input signal that contains teletext data in vertical blanking intervals thereof;

a control computer;

a display memory;

a computer controlled teletext circuit responsive to a select teletext page command signal issued by the control computer in response to a user page request to acquire, from said data derived by the video input processor, data corresponding to a selected teletext page, to store said acquired data in the display memory, and to decode said acquired teletext data into a format capable of being displayed, the computer controlled teletext circuit being capable of adopting either a vertical blanking interval mode, in which it looks for teletext data only in lines in vertical blanking intervals of a video signal, or a full field mode in which it looks for teletext data in all lines of a video signal;

a buffer memory capable of storing a plurality of pages of teletext data; and

a memory controller connected to receive the data derived by the video input processor and operative continuously to extract teletext data therefrom and store the extracted teletext data in the buffer memory such that the oldest data is overwritten by the newest data whereby the buffer memory contents are continuously updated, the memory controller including means for detecting and inhibiting the storage in the buffer memory of at least one predetermined teletext extension packet;

the control computer being responsive to a user page request to put the computer controlled teletext circuit into the full field mode and to supply to the memory controller a scan request signal that causes it to supply to the computer controlled teletext circuit, in place of the data derived by the video input processor, the teletext data stored in the buffer memory.

2. Apparatus according to claim 1, wherein:

the computer controlled teletext circuit is responsive to detecting teletext data corresponding to the selected page in the stored teletext data supplied thereto from the buffer memory to set a flag and the control computer is responsive to the flag to terminate the scan request signal and put the computer controlled teletext circuit into the vertical blanking interval mode; and

the memory controller is responsive to the scan request signal not having been terminated when all the stored teletext data has been supplied to the computer controlled teletext circuit to supply to the control computer a scan complete signal, the control computer being responsive thereto to put the computer controlled teletext circuit into the vertical blanking interval mode.

3. Apparatus according to claim 1 or claim 2, wherein the means for detecting and inhibiting is operative to detect and inhibit the storage of extension packet 31.

4. Apparatus according to claim 1, claim 2 or claim 3, wherein the means for detecting and inhibiting is operative to detect and inhibit the storage of extension packet 30.

5. Apparatus according to any one of the preceding claims, wherein the memory controller includes a timing circuit operative to permit storage of a predetermined number of bytes, after detection of a framing word, corresponding to the remainder of the teletext data in a line of the video input signal, and wherein the timing circuit can be controlled to vary said predetermined number to have either a value appropriate to a 625 line video system or a value appropriate to a 525 line video system.

6. Apparatus according to any one of the preceding claims, wherein:

means is provided for deriving synchronisation information from the video input signal;

the memory controller includes a teletext framing word detector and window generator means responsive to the synchronisation information to enable the framing word detector in lines of the

vertical blanking intervals in which teletext data may occur and at a position in each such line at which a teletext framing word may occur, the framing word detector being responsive to detection of a framing word in the data derived by the video input processor to enable storage in the buffer memory of the teletext data following the framing word in that line; and

the window generator means can be configured to enable the framing word detector either at a timing appropriate to a 625 line video system or at a timing appropriate to a 525 line video system.

7. Apparatus according to claim 6, wherein:

the window generator means is responsive to the synchronisation information to generate a position signal indicative of the timing at which teletext data stored in the buffer memory should be supplied to the computer controlled teletext circuit on receipt of a scan request signal;

the memory controller is operative to detect framing words of stored teletext data being outputted by the buffer memory and to synchronise the outputted stored teletext data with the position signal; and

the window generator means can be configured to produce the position signal either at a timing appropriate to a 625 line video system or at a timing appropriate to a 525 line video system.

8. Apparatus according to any one of the preceding claims, wherein the buffer memory is capable of storing at least the amount of teletext data (less that in the at least one extension packet whose storage is inhibited) that can be contained in one teletext magazine.

9. Apparatus according to any one of the preceding claims, wherein the memory controller includes a magazine detector operative to detect whether or not each line of the teletext data it receives is data from at least one predetermined teletext magazine and the memory controller is operative to store the teletext data only if the data is from the at least one predetermined magazine.

10. Apparatus according to claim 9, wherein the at least one predetermined teletext magazine that the magazine detector is operative to detect can be selectively varied.

11. Apparatus according to any one of the preceding claims, wherein the memory controller includes an address counter operative to count up to a predetermined value to control storage of the extracted teletext data in the buffer memory, and wherein the predetermined value can be changed to conform with different buffer memory capacities.

12. A teletext decoding apparatus substantially as herein described with reference to the accompanying drawings.

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